constantly testing and quickly remedying this cardinal element of polar alignment is a great comfort as the hour of totality approaches, when a hundred other details crowd for instant attention.

Note on some Results obtained with a Small Prismatic Camera at the Eclipse Camp at Talni. By J. Evershed.

The eclipse work which I undertook in India this year was entirely spectroscopic, and covered practically the same ground as that which I attempted in Norway in 1896. It consisted in obtaining photographs of the spectra of the chromosphere, prominences, and corona.

For this purpose I constructed three photographic instruments: a prismatic camera of $2\frac{1}{4}$ inches aperture and 36 inches focal length, fitted with two 60° prisms; a slit spectrograph, containing two quartz prisms; and a large slitless spectrograph attached to a 6-inch telescope, the latter being mounted on a roughly made equatorial stand.

In addition to these I had available a 4-inch polar heliostat, kindly lent by Mr. Maw, and a $3\frac{1}{4}$-inch equatorial telescope with solar spectroscope attached. The heliostat was used to supply light to the prismatic camera and the slit spectrograph. It was of the ordinary form with two mirrors, but was modified to suit the special work by removing the second mirror and mounting it in the same plane as the first, so that two beams of light were available instead of one beam twice reflected. The tele-spectroscope was used to observe the reversing layer visually, and to determine the right moment to expose the prismatic camera and large slitless spectrograph in order to photograph the "flash" spectrum.

I obtained thirteen photographs in all: one only with the slit spectrograph, which was exposed during the whole time of totality; two with the slitless spectrograph—one at the beginning and one at the end of totality; and a series of ten with the prismatic camera, beginning about 20 seconds before second contact and ending about the same interval after third contact.

The single photograph obtained with the slit spectrograph shows no details of any kind on the very faint continuous spectrum of the corona. The large slitless spectrograph yielded two fairly good negatives, which show a considerable number of bright lines in the region of the spectrum between F and H. The best results were, however, obtained with the prismatic camera. This instrument gave images of the spectrum extending from λ 6000 in the orange to λ 3380 in the ultra-violet. Unfortunately the scale is very small; it is only ·33 inch to the Moon's diameter, and in length 1·52 inches from D to H, the total length of the spectrum photo-

graphed being 2·9 inches. Notwithstanding this, however, a large amount of detail is visible on some of the plates, and the definition is excellent in the ultra-violet region.

The first two photographs of the prismatic camera series were exposed at about 20 seconds and 12 seconds before totality respectively. At these times the last remaining thread of sunlight had narrowed down to a width of 8″ for the first and about 4″ for the second exposure, at the widest part of the cusp, and, acting as a fine slit, gave excellent spectral images. Accordingly, the photographs show the ordinary Fraunhofer spectrum very finely, but the lines are much less dark than in the ordinary solar spectrum ; the F line in particular seems to be almost obliterated by the bright chromosphere radiation H and K, and all the hydrogen lines except C, are represented in the photographs by bright arcs extending on each side of the continuous spectrum, and numerous other short bright arcs can be made out in the ultra-violet.

The next plate (No. 3) was exposed about 2 seconds before the last remnant of photosphere vanished, and was allowed to remain exposed for about 4 seconds. Just before making this exposure I removed the slit of the visual spectroscope and watched the narrowing cusp-spectrum in the region near *b* without any slit, beginning to observe not more than 10 seconds before totality.

At first I could see the Fraunhofer dark line spectrum very clearly, just as though the circular slit ordinarily used in observing the prominences was still in place. The continuous spectrum rapidly decreased in width, and then, instead of narrowing down to a single thread of light, as I had expected, it suddenly began to break up into a number of narrow bands, between which the bright lines flashed out in the most astonishing way, extending in long arcs over thirty degrees or more of the limb. I then made the exposure.

In the photograph only the stronger lines in the part of the spectrum observed have been impressed. In the ultra-violet, however, the spectrum is thickly crowded with bright lines. In this region the lines seem to be intrinsically more intense than in the lower spectrum, whilst the continuous spectrum of the photosphere is relatively feeble. All the bright lines throughout the spectrum, excepting those due to the chromosphere proper, form a well-defined band of uniform width running the whole length of the spectrum. The length of the arcs, or width of the band of bright lines, corresponds to an arc of over 40 degrees of the Sun's limb, and this implies a depth not exceeding 1″·5 for the gases composing the reversing layer.* The extreme thinness of the layer is evidenced also by the well-defined dark bands running lengthwise from end to end of the spectrum, and interrupting all

* Assuming the Moon's apparent semi-diameter = 997″·0, and the Sun's = 974″·9.

the bright lines of the flash spectrum. These are due to the projecting lunar mountains, which had already in places occulted the reversing layer, even before the eclipse was quite total.

Plate No. 4 was given an instantaneous exposure a few seconds after totality had commenced. It shows simply the ordinary chromosphere spectrum; but there is a curious feature in the prominence spectrum which is well brought out in this photograph. In the extreme ultra-violet most of the prominences give an apparently continuous spectrum. This appears to commence abruptly at about λ 3660, at the point where the hydrogen series ends, and it extends in an unbroken line to the end of the plate, at about λ 3390.

Of the remaining photographs of the series, Nos. 7, 8, and 10 are the most interesting. No. 7 was given an exposure of about 30 seconds, ending just before third contact; the corona line and many of the flash spectrum lines are clearly shown; they are crossed by narrow streaks of faint continuous spectrum. The distribution of the "1474" light seems to conform in a general way to the structure of the corona; but it is much stronger on the east limb than on the west, where it is scarcely traceable. In this photograph the entire series of hydrogen lines are shown, including α.

No. 8 was exposed at the moment when the photosphere broke out, and a large number of the flash spectrum lines are shown between the streaks of continuous spectrum. The focus is, however, not so good as in No. 3.

No. 10, which was exposed about 18 seconds after totality was over, is remarkable for the fringe of bright lines bordering the continuous spectrum in the ultra-violet, where, apparently, *every* dark line of the Fraunhofer spectrum ends in a short bright line.

With regard to the question of the relation between the bright lines of the flash spectrum and the dark lines of the Fraunhofer spectrum, it would be exceedingly rash to draw any definite conclusions from these negatives, pending the discussion of the magnificent results obtained by Sir Norman Lockyer and others. It may be stated, however, as the result of a preliminary examination of the plates, that while the flash spectrum cannot be regarded as the exact converse of the Fraunhofer spectrum, yet the correspondence between the two is a sufficiently striking one, and from it one might infer that the majority of the dark lines in the solar spectrum are really due to absorption in the reversing stratum.

But in studying the flash spectrum it is very necessary to bear in mind that, although apparently very shallow, the reversing layer is really something like 800 miles in depth, with probably an enormous increase of density near the base, or, rather, in the region where the photospheric clouds are precipitating.

Under such conditions the main part of the absorption producing the Fraunhofer spectrum probably takes place within a

few miles only of the photospheric clouds. (It does not seem necessary to suppose it to take place within or between the clouds, although this may, of course, be the case to some extent.)

The flash spectrum, however, as we see it, represents the higher part of the stratum, which is not nearly so effective in producing absorption, on account of the much lower density; and if the various gases concerned are not uniformly distributed throughout the layer, the relatively shallow but dense stratum at the base may contain gases which are not present in the region above, and *vice versâ*.

On this view, helium and other gases having prominent lines in the flash spectrum, which are only feebly represented, or are not present at all, in the Fraunhofer spectrum, are gases which exist only in the upper regions of low density. It is not necessary to suppose that the temperature of these gases is as high as that of the photospheric background, but simply that a ray of light, emitted by the photosphere in its passage outwards, encounters relatively few molecules, notwithstanding that the gases may extend to great elevations in the chromosphere.

It is evident that the strength of a bright line in the chromosphere or flash spectrum depends to a large extent on the height to which the gas producing it extends, and is independent of the density or total quantity of gas overlying the photosphere by which the intensities of the dark lines are mostly determined.

Thus, by assuming a somewhat irregular distribution of the gases in the layer itself, the differences between the Fraunhofer and flash spectra may be accounted for without abandoning the view that the greater part, if not the whole, of the gaseous absorption takes place between the photosphere and the upper limits of the reversing layer.

Note on the Zodiacal Light. By E. Walter Maunder.

The recent eclipse expedition to India gave me the first favourable opportunity for observing the Zodiacal Light. I had seen it on a few occasions in England, but the contrast between the faint glimmer, doubtfully seen on a few rare occasions here, and the broad bright glow, which it was impossible to mistake or overlook, seen on every moonless evening during both the outward and homeward voyage, and during our camp life in India, was so great as to seem to make it a duty to utilise such an opportunity as fully as possible. The observations cover a period of two calendar months—1897 December 22 to 1898 February 22—they are, of course, therefore of but little value as compared with a series of observations carried on continuously throughout the entire course of the year. Nevertheless I thought it worth while to submit them to the Society in the hope that they might call the attention